



**Evergreen Resources Management**  
2 Righter Parkway, Suite 200  
Wilmington, DE 19803

January 10, 2018

Mr. Kevin Bilash  
United States Environmental Protection Agency  
Region III  
1650 Arch Street  
Philadelphia, PA 19103-2029

**Re: USEPA November 20, 2017 Comment Letter to  
June 27, 2017 RCRA Facility Investigation Report for AOI 7  
Former Ethylene Complex Marcus Hook Industrial Center**

Dear Mr. Bilash:

Evergreen Resources Group, LLC (Evergreen) has prepared this letter in response to the EPA's November 20, 2017 letter concerning Evergreen's June 27, 2017 RCRA Facility Investigation Report (RFI) for AOI 7 Former Ethylene Complex, Marcus Hook Industrial Center located in Claymont, Delaware. The EPA's November 20, 2017 comment letter was discussed during a meeting between representatives from the EPA (Kevin Bilash and Paul Gotthold), Evergreen (Jim Oppenheim) and GHD (Colleen Costello) on December 21, 2017 in USEPA, Region 3 offices in Philadelphia, PA.

The EPA requested further investigatory work be performed prior to the EPA submitting inclusive comments to the AOI 7 FRI. The EPA's November 20, 2017 comment letter suggested additional items to be completed by Evergreen to assist in current remedial efforts ongoing at the adjacent Delaware Valley Works/General Chemical Corporation/Honeywell Facility (DVW). Each of EPA's suggested items and Evergreen's response is included below:

1-EPA suggested item

Confirm elevated groundwater arsenic concentrations in wells along the shoreline.

Evergreen's response

The AOI 7 RFI contains groundwater data in monitoring wells located along the shoreline with elevated groundwater arsenic concentrations. As discussed during the December 21, 2017 meeting, the elevated arsenic concentrations are detected in MW-560, MW-531L and MW-532L, as shown on Figure 3.1 of the AOI 7 RFI included in Attachment A. The arsenic concentrations in these wells are not due to current or former operations in AOI 7 but rather due to historic releases from the neighboring Delaware Valley Works/General Chemical Corporation/Honeywell Facility site. This conclusion is based on the history of AOI 7 and the observed data patterns, as discussed further below. Evergreen plans to complete additional groundwater sampling as part of the Corrective Measure Studies (CMS) development.

Topography in AOI 7 was naturally low lying coastal plain prior to development in the early 20th century. These low lying areas were reclaimed by the placement of fill to raise the ground surface above the Delaware River and provide a stable base for subsequent development. Figure 2.3 from the AOI 7 RFI included in Attachment A, shows changes to the river bank based on historical aerial photographs that are shown on Figures 2.4A and 2.4B from the AOI 7 RFI, included in Attachment A.

The progress of this fill placement is most noticeable from 1953 through 1965. Between 1953 and 1958 an area 250 feet wide adjacent to the western property line was filled out approximately 500 feet toward the river to the current bulkhead line. Between 1958, when the property south of Middle Creek was sold to SunOlin, and 1962, after construction of the Ethylene and Ethylene Oxide units, the remaining riverfront margin of AOI 7 was filled to the current bulkhead line. The materials were placed to bring the elevation of the area to 15 feet above mean sea level (AMSL) and then eventually to the current elevation of approximately 19 feet AMSL in the southern portion of AOI 7. The rerouting of Middle Creek to its current location is depicted in an aerial photograph from 1958 (Figure 2.4B from the AOI7 RFI, included in Attachment A) and shows a 90 degree turn to the southeast to a new discharge point at the Delaware River near the property boundary.

As seen on Figure 2.4A from the AOI 7 RFI included in Attachment A, industrial activity at the Delaware Valley Works/General Chemical Corporation/Honeywell Facility was ongoing to the west of AOI 7 prior to the filling and development of the Ethylene Complex area, which began in the late 1950s. Filling activity at the DVW was noticeable adjacent to the AOI 7 boundary as early as 1937, and bermed areas that appear to have received siltation are apparent in the 1950s. A large pond and an apparent disposal pile on the DVW property appear just west of the property boundary in the 1965 aerial photograph (Figure 2.4B from AOI 7 RFI, included in Attachment A). Tonality in the 1937 aerial photograph indicates the presence of mud flats and unconsolidated sediment material spanning the riverfront from DVW east to AOI 7. This pattern indicates the movement of materials from the adjacent DVW property to locations within the current AOI 7 boundary. This area on the Delaware Valley Works/General Chemical Corporation/Honeywell Facility became Solid Waste Management Unit 9 (SWMU 9), which was used for disposal of pesticides and related wastes, materials from DDT and DDD production, and laboratory samples disposal. SWMU 9 started as a settling pond in the area adjacent to AOI 7 (called Parcel 1) and was constructed by placing a bulkhead along the Delaware River and placing alum mud for dewatering. The Lower Sluiceway, a primary discharge point for the former DVW South Plant is located on the west side of SWMU 9.

Some of the key observations from this history and the current data that support the conclusion that the elevated arsenic concentrations in groundwater in AOI 7 are from the Delaware Valley Works/General Chemical Corporation/Honeywell Facility include:

- The historic aerials included in the AOI 7 RFI (Figures 2.4A and 2.4B in Attachment A), particularly the 1937 and 1954 historic aerials, clearly demonstrate the materials migrating from the Delaware Valley Works/General Chemical Corporation/Honeywell Facility into the area where the monitoring wells with the elevated arsenic groundwater concentrations (MW-560, MW-531L and MW-532L) are observed within AOI-7.
- Both MW-531L and MW-532L were installed as well couplets with MW-531U and MW-532U. The L series wells are approximately 30 feet below grade and the U series wells are approximately 10 feet below grade. MW-531U and MW-532U, do not have elevated arsenic concentrations and neither of these wells exceed the General Chemical/Honeywell RG of 1,253 ug/L established for pore water. These wells are shown on the cross section A-A' (Figure 1). The L series wells represent the elevation of the materials that were deposited from the Delaware Valley Works/General Chemical Corporation/Honeywell Facility, whereas the U wells represent the elevation of the fill materials within AOI 7. None of the other wells in AOI 7, even those completed at depths similar to MW-531L and MW-532L, have similar elevated arsenic levels since they were not as heavily impacted from this off-site source. If the arsenic impacts in MW-531L, MW-532L and MW-560 were due to historic Sunoco activities, arsenic would be detected in other AOI 7 monitoring wells at similar levels. Table 1 summarizes the arsenic data and well depths for MW-531L, MW-531U, MW-532L, MW-532U and MW-560.

Table 1  
AOI 7 - RFI  
Arsenic Groundwater Data

Location	MW-531L	MW-531U	MW-532L	MW-532U	MW-560
Sample Date	07/01/16	06/28/16	07/07/16	07/05/16	1/20/16
Arsenic (ug/l)	192,000	1,170	1,360,000	183	55,800
Sample Depth (AMSL)	-19.99	-4.3	-19.52	-4.93	-8.56

Notes:

1. The highest detected arsenic concentration from the AOI 7 RFI groundwater sampling events in these wells is listed in this table. See the AOI 7 RFI for all of the groundwater data from these wells.
  2. The sample depths in the table are the bottom of the screen intervals.
  3. The arsenic AOI 7 RFI groundwater data is dissolved concentrations.
- As shown on Figure 1, MW-560 is located immediately adjacent to the Delaware Valley Works/General Chemical Corporation/Honeywell Site across Middle Creek. Middle Creek was re-routed in 1958 and the majority of filling to create the Ethylene Complex was completed after the re-routing of Middle Creek therefore MW-560 is unlikely to have been impacted by these filling events. Since MW-560 is located closer to the source of the off-site impacts, higher arsenic concentrations are observed at more shallow well depths as shown in Table 1, which is consistent with other groundwater data collected at the Delaware Valley Works/General Chemical Corporation/Honeywell Facility.

Based on the review of the EPA's files for the Delaware Valley Works/General Chemical Corporation/Honeywell Facility, summarized in Appendix D of the AOI 7 RFI, there are no groundwater wells within SWMU 9 on the Delaware Valley Works/General Chemical Corporation/Honeywell Facility. Three groundwater hydropunch samples were collected in SWMU 9 in 2003 from SM09-GW01, SM09-GW02, and SM09-GW03 and the results with the approximate sample depths are summarized on Table 2. These results correlate with observations in MW-560 that the elevated arsenic concentrations are found at more shallow depths on the Delaware Valley Works/General Chemical Corporation/Honeywell Facility. This is further supported by the sampling of six wells located around SWMU 9 (MW-14 through MW-19) and an upgradient well (MW-113) in 2004 that showed elevated arsenic concentrations. None of these samples however, were collected at the depths of MW-531L and MW-532L on the AOI 7 property, as shown on Figure 1.

The fact that the Delaware Valley Works/General Chemical Corporation/Honeywell Facility is currently detecting arsenic in porewater samples correlates with the fact that arsenic at high concentrations is present at shallower depths on that property. Shallower arsenic groundwater concentrations are more likely to impact porewater in the Delaware River than would deeper groundwater concentrations seen in MW-531L and MW-532L..

Table 2  
Historic Investigations  
Delaware Valley Works/General Chemical Corporation/Honeywell Facility  
Arsenic Groundwater Data

Location	SM09- GW01	SM09- GW02	SM09- GW03	MW-113	MW-14	MW-15	MW-16	MW-17	MW-18	MW-19
Sample Date	6/4/03	6/4/03	6/4/03	2/5/03	12/17/04	12/11/04	12/20/04	12/20/04	12/20/04	12/20/04
Arsenic (ug/l)	22.5	577	101,000	1,700,000	16,600	293	269	8.5	66,900	33,200
Sample Depth (AMSL)	3	-3.0	-6	NA	-3.86	-3.13	-6.3	-6.9	-14.9	-0.05

Notes:

1. The highest detected arsenic concentration from the groundwater sampling events from the EPA file review are listed in this table. See the AOI 7 RFI, Appendix D for all of the available groundwater data from these wells.
2. The sample depth is approximate based on approximate ground elevations and reported sample depths. No well depth was available for MW-113 in the reviewed materials.
3. Samples SM09-GW01 through SM09-GW03 as reported in 2003 RFI Data Summary.
4. Samples MW-113, MW-14 through MW-19 as reported in 2005 Phase II RFI Data Summary Report.

2-EPA suggested item

Characterize arsenic in sediments and porewater.

Evergreen's response

Arsenic has been characterized in sediments in Middle Creek as well as being assessed through an ecological risk assessment. In the ecological risk assessment the arsenic results were evaluated against the alternative sediment benchmark (PRG) developed by Environ 2012 which was 300 mg/kg in Middle Creek. Two locations at the mouth of Middle Creek did have some exceedances of that PRG due to offsite impacts from Delaware Valley Works/General Chemical Corporation/Honeywell Facility. The ecological risk assessment evaluated these results in context with the rest of the sediment and surface water results in Middle Creek and it was determined that there was no unacceptable risk due to arsenic in the sediments in Middle Creek as is summarized in Appendix N (Screening-Level Ecological Risk Assessment) of the AOI 7 RFI. Since there is no unacceptable risk from the sediments and the groundwater that is discharging into Middle Creek, there was no need to collect porewater samples. If porewater data is needed for the remedial design for the Delaware Valley Works/General Chemical Corporation/Honeywell Facility, then the companies involved with that effort should collect the information for their design.

3-EPA suggested item

Estimate mass flux from the groundwater to surface water pathway.



#### Evergreen's response

Section 4.2 of the AOI RFI established a geometric mean concentration for groundwater discharging to the Delaware River and Middle Creek. Twenty-two wells were evaluated within 300 feet of the Delaware River to represent conditions in the groundwater discharge zone. This area of AOI 7 has been shown to be hydraulically connected with the river as demonstrated by tidal influence observations described in Section 4.2.1.1 of the AOI 7 RFI. Similarly, a geometric mean concentration from the 15 wells along Middle Creek was calculated and documented in the AOI 7 RFI. These concentrations were then used with site hydraulic data, as summarized in Attachment B, to calculate a potential mass flux. The calculated mass flux to the Delaware River is 0.012 lb/day.

#### 4-EPA Suggested Item

Estimate arsenic loading from Middle Creek to the Delaware River.

#### Evergreen's Response

Since the ecological risk assessment of Middle Creek did not identify an unacceptable risk, no additional sediment loading evaluations were completed during the RFI for AOI 7, so this information is not available. If this information is needed for the remedial design for the Delaware Valley Works/General Chemical Corporation/Honeywell Facility, then the companies involved with that effort should collect the information for their design.

Should you have any questions on the above, please do not hesitate to contact myself or Colleen Costello of GHD.

Yours truly,

A handwritten signature in blue ink, appearing to read 'James Oppenheim', is written over a light blue horizontal line.

James Oppenheim, PE

Enclosures

cc: Collen Costello, GHD

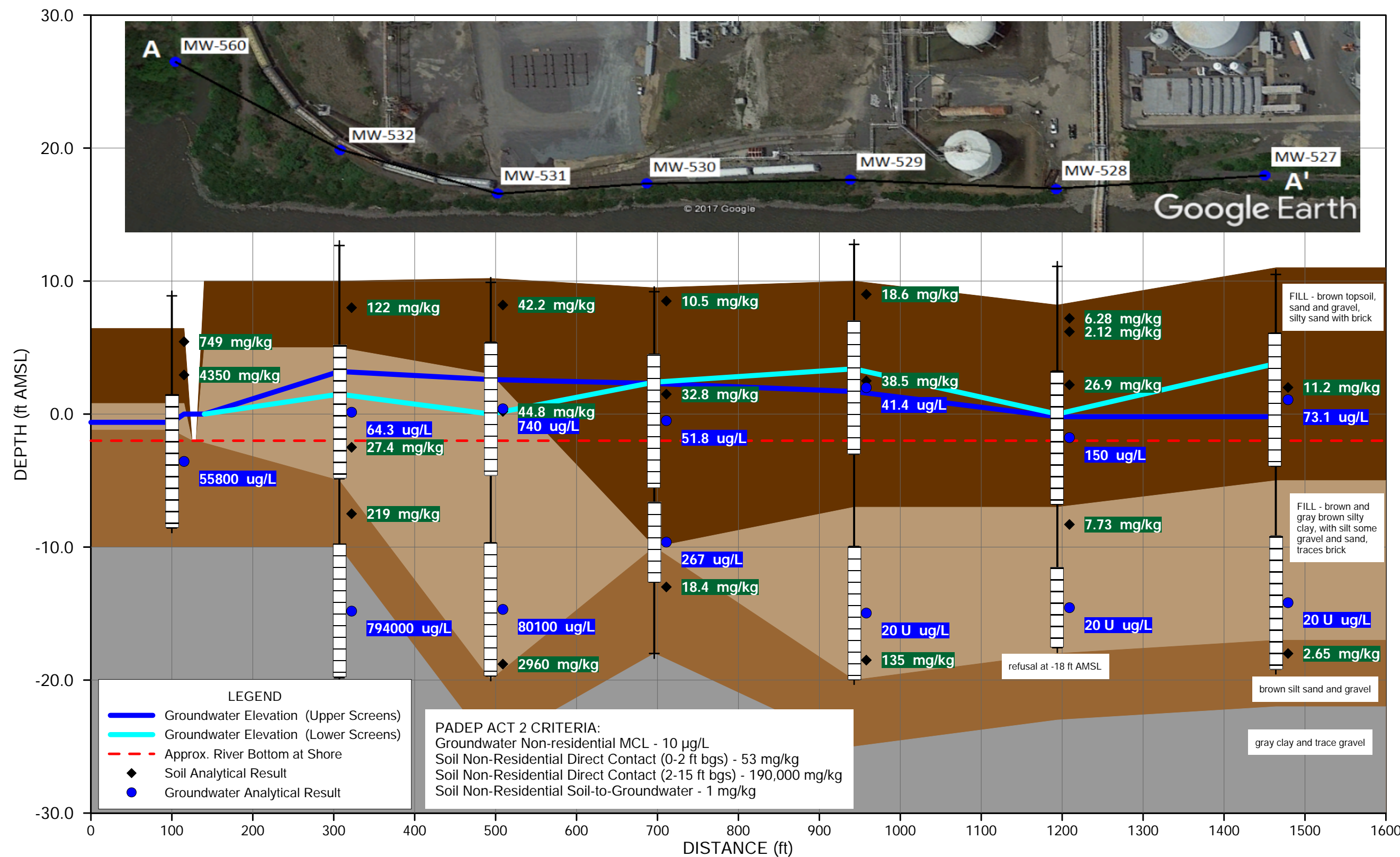


figure 1

CROSS-SECTION A-A'

SOIL AND GROUNDWATER CONCENTRATION ALONG THE DELAWARE RIVER - ARSENIC

MARCUS HOOK INDUSTRIAL COMPLEX - AOI7

EVERGREEN

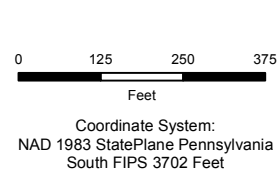


ATTACHMENT A  
FIGURES FROM AOI 7 MHIC RCRA FACILITY INVESTIGATION REPORT





Source: Aerial: Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation



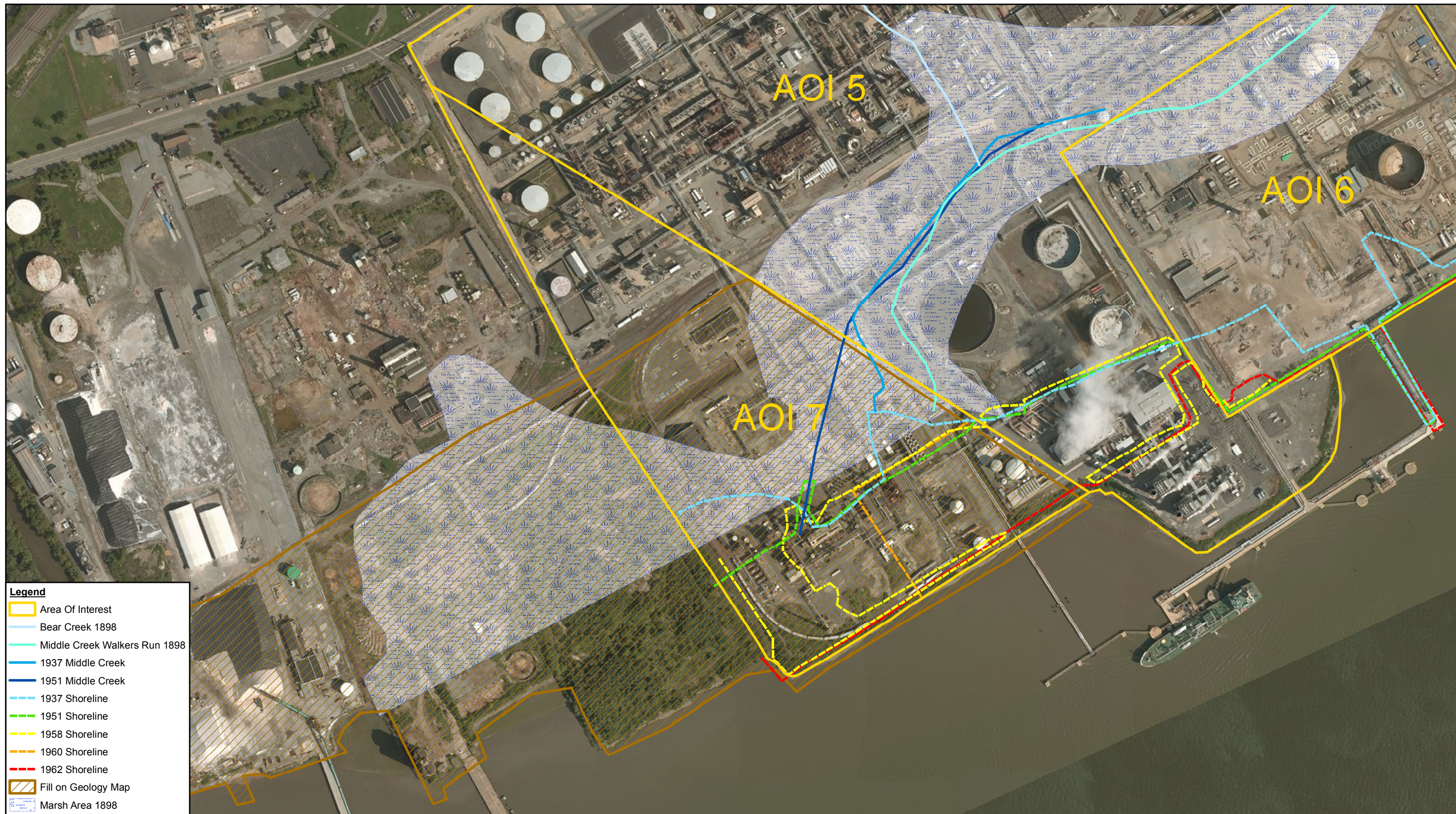
EVERGREEN RESOURCES MANAGEMENT  
MARCUS HOOK INDUSTRIAL COMPLEX  
RFI - AOI 7

LOCATION OF RFI ACTIVITIES (RFI SAMPLING LOCATIONS)

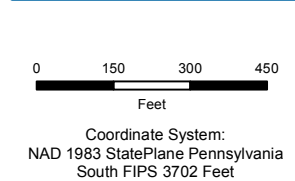
11102641-07  
Apr 25, 2017

FIGURE 3.1





Source: Marsh area 1898 from Topographic Map of the Chester, PA Quadrangle obtained from the United States Geological Survey and screen-digitized by Stantec in a GIS; Shorelines and creek positions interpreted by GHD from historical aerial photographs; Delaware digital geology data obtained from the Delaware Geological Survey Geologic Map Series No. 13. Aerial: Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation



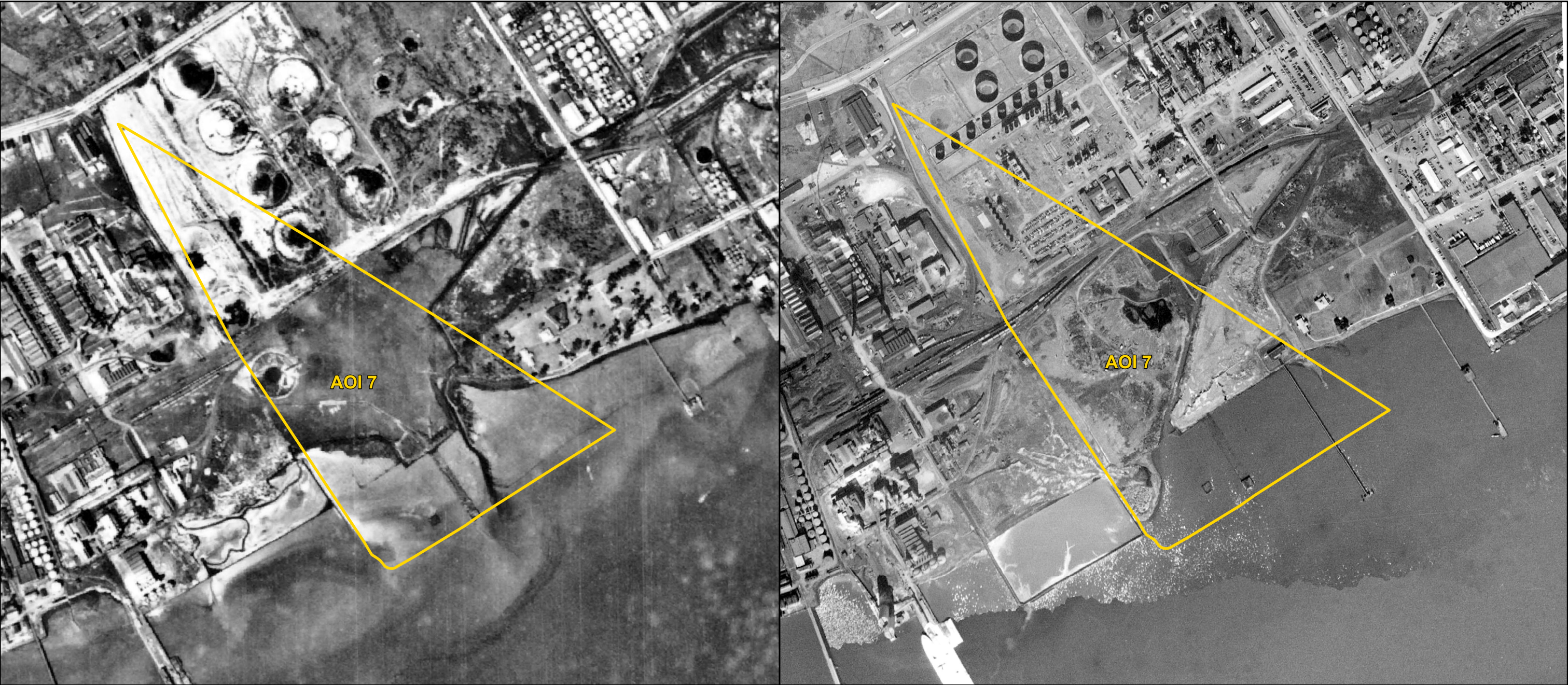
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RFI - AOI 7

CHANGES IN MIDDLE CREEK LOCATION AND DELAWARE RIVER  
SHORE LINES

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Apr 21, 2017

FIGURE 2.3






1937

1953


**Legend**

 Area Of Interest

Source: Aerials acquired from historicaerials.com

0 205 410 615  
Feet

Coordinate System:  
NAD 1983 StatePlane Pennsylvania  
South FIPS 3702 Feet



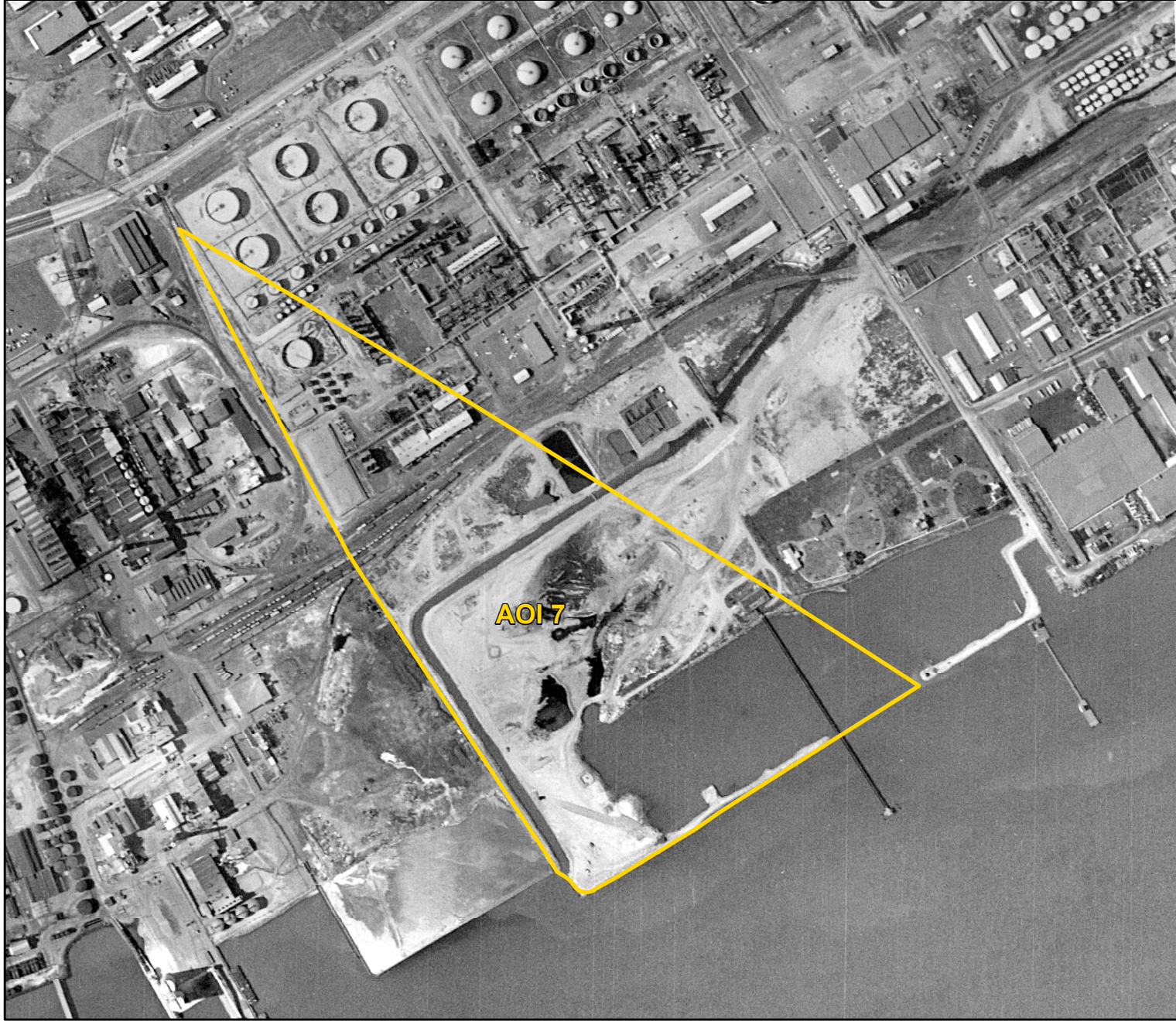
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RFI - AOI 7

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Nov 28, 2016

SELECTED HISTORICAL AERIAL PHOTOGRAPHS OF AOI 7

FIGURE 2.4A





1958



1965

**Legend**

Area Of Interest

Source: Aerials acquired from historicaerials.com

0205410615

Feet

Coordinate System:  
NAD 1983 StatePlane Pennsylvania  
South FIPS 3702 Feet



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RFI - AOI 7

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SELECTED HISTORICAL AERIAL PHOTOGRAPHS OF AOI 7

FIGURE 2.4B



ATTACHMENT B  
CALCULATION OF GROUNDWATER ARSENIC FLUX



**Attachment B**  
**Calculation of Groundwater Arsenic Flux**  
**AOI 7 Marcus Hook Industrial Complex**  
**Evergreen Resources Management**

**Groundwater Concentration**

Location	Type	Sample Date	Dissolved As (ug/L)
MW-527L	Monitor Well	06/27/2016	16.8
MW-527U	Monitor Well	06/27/2016	60.95
MW-528L	Monitor Well	06/27/2016	10
MW-528U	Monitor Well	06/27/2016	21.9
MW-533L	Monitor Well	06/29/2016	24.1
MW-533U	Monitor Well	06/29/2016	583
MW-509	Monitor Well	06/30/2016	833
AOI7_MHIC_DE_MC_SEEP	Seep	09/01/2015	129
MW-529L	Monitor Well	06/27/2016	145
MW-529U	Monitor Well	06/28/2016	10
MW-530L	Monitor Well	06/28/2016	205
MW-530U	Monitor Well	06/28/2016	26.8
MW-531L	Monitor Well	07/01/2016	192000
MW-531U	Monitor Well	06/28/2016	1170
MW-532L	Monitor Well	07/07/2016	1360000
MW-532U	Monitor Well	07/05/2016	183
MW-534L	Monitor Well	07/01/2016	31600
MW-534U	Monitor Well	07/01/2016	392
MW-53	Monitor Well	07/05/2016	10
MW-55	Monitor Well	07/01/2016	14.6
MW-56	Monitor Well	07/01/2016	127000
MW-559	Monitor Well	6/30/2016	124.00
MW-560	Monitor Well	6/30/2016	12900
geomean			358.15101
number ND			6

Notes:

Data from most recent groundwater data results from MHIC AOI 7 RCRA Facility Investigation  
 ND set equal to **half detection limit**; R set to 0 (no material impact if deleted)

**Groundwater Flow**

<b>Fill Hydraulic Conductivity</b>	<i>from slug test</i>	<b>0.4753</b>	<b>ft/day</b>
<b>Gradient <i>i</i></b>	<i>MW-57 to MW-58</i>	<b>0.0100</b>	<b>ft/ft</b>
<b>porosity <i>n</i></b>		<b>0.3</b>	
<b>Pore Velocity</b>	<i>k*i/n</i>	<b>0.0158</b>	<b>ft/day</b>
<b>AOI-7 shorefront length</b>		<b>1400</b>	<b>ft</b>
<b>Saturated Thickness</b>		<b>23</b>	<b>ft</b>
<b>Groundwater Flow</b>		<b>510</b>	<b>cuft/day</b>
<b>Groundwater Flow</b>		<b>3,984</b>	<b>gal/day</b>
<b>Groundwater Flow</b>		<b>15,061</b>	<b>liters/day</b>

**Groundwater Arsenic Flux**

<b>As Concentration-Geomean</b>		<b>358.15</b>	<b>ug/L</b>
<b>As flux in groundwater</b>	<i>ug/L * L/day</i>	<b>5,394,006</b>	<b>ug/day</b>
<b>As flux in groundwater</b>	<i>ug/day*1000 ug/mg</i>	<b>5394.01</b>	<b>mg/day</b>
<b>As flux in groundwater</b>	<i>mg/day*1000 mg/g</i>	<b>5.39</b>	<b>g/day</b>
<b>As flux in groundwater</b>	<i>g/day/454 g/lb</i>	<b>0.012</b>	<b>lb/day</b>
<b>As flux in groundwater</b>	<i>lb/day*365 day/yr</i>	<b>4.34</b>	<b>lb/year</b>